LENA®

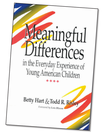
Building brains through early talk

Language Experience in the Second Year of Life and Language Outcomes in Late Childhood

Jill Gilkerson, PhD[1,2], Jeffrey A. Richards, MA[1], Steven F. Warren, PhD[3], Kimbrough Oller, PhD[4,5,6], Rosemary Russo, MA[1], Betty Vohr, MD[7,8]

[1]LENA Foundation, Boulder, CO; [2]University of Colorado at Boulder; [3]Institute for Life Span Studies, University of Kansas; [4]School of Communication Sciences and Disorders and [5]Institute for Intelligent Systems, The University of Memphis; [6]Konrad Lorenz Institute for Evolution and Cognition Research, Klosterneuburg, Austria; [7]Department of Pediatrics, Warren Alpert Medical School, Brown University, Providence, RI; and [8]Department of Pediatrics, Women and Infants Hospital of Rhode Island, Providence, RI

Background



- Hart & Risley (1995) recorded and transcribed one hour per month of the home language environments of 42 children 8-36 months of age for three years
- They found that children from lower SES families experienced a paucity of language relative to their higher SES peers, up to 30M words by age 4
- Follow-up analyses on these children after age three revealed that quantity of early language interaction predicted child IQ and later academic success

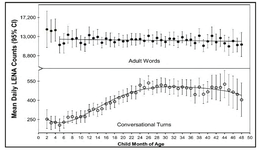
LENA Normative Study (AJSLP, 2017)

- **Original Purposes**
  - Investigate familial patterns of adult/child talk and interaction measured automatically over a full day
  - Generate a normative reference dataset for Adult Word Count (AWC) and Conversational Turns (CT)
- **Participants:** 329 children ages 2-48 months, balanced by age, SES
- **Recordings:** Families recorded 12 hrs/day, 1x/month for 6 months
  All baseline recordings — parents received no feedback
- **Child Assessments:** Evaluations by certified Speech Language Pathologist
  - Preschool Language Scale, 4th Ed. (PLS-4); Receptive-Expressive Emergent Language Test—3rd Ed. (REEL-3); Cognitive Adaptive Test/Clinical Linguistic Milestones Scale (CAT/CLAMS); MacArthur-Bates Communicative Development Inventory (MB-CDI); Child Development Inventory

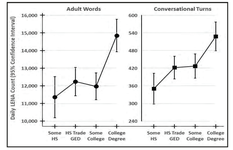
Gilkerson, J., Richards, J.A., Warren, S.F., Montgomery, J.K., Greenwood, C.R., Oller, D.K., & Hansen, J.H. (2017). "Mapping the early language environment using all-day recordings and automated analysis." American Journal of Speech-Language Pathology, 26 (2), pp 248-265.

LENA Metrics: Adult Word Count and Conversational Turns

Conversational Turns on Average Vary With Child Age — Adult Words Do Not



LENA Metrics on Average Vary Across Family SES Groups



LENA Metrics Correlate with Concurrent Standard Assessments

		Conv Turns	Adult Words
Measure	N	r	r
PLS-4	306	.30	.21
REEL-3	265	.35	.22
CLAMS	258	.34	.21
CAT	258	.30	.18
MB-CDI	182	.35	.28
Child Dev Inv	203	.38	.16*

All p < .01 except *p < .05

How Does LENA Work?

Daylong audio recordings are collected as the child wears a lightweight digital recorder in the chest pocket of specially-designed clothing. Recorded audio data are automatically segmented by software algorithms into a sequence of eight sound categories: Key Child, Other Child, Adult Male, Adult Female, Overlap, Noise, Silence, and TV/Electronic Media. Non-silence categories are further divided based on maximum likelihood testing into clear/faint subcategories. Other quantifications of interest derive from these segmentation classifications.

Parents turn on the recorder and place it in the pocket of the child's LENA clothing at the beginning of the recording session (typically when the child first wakes up in the morning).

At the end of the recording session, parents plug the LENA recorder into a Windows computer. LENA analysis software automatically uploads and processes the audio recording file.

The processing results can be generated in different formats. The resolution of the reports can be time-based (seconds, minutes, hours, days, etc.), or by sound segment.

Longitudinal Follow-Up (Pediatrics, 2018)

- **Purpose:** Investigate whether the automated analysis of a young child's early language environment predicts language and cognitive outcomes ten years later in adolescence
- **Participants:** 146 Normative Study children, now 9-14 years old
- **SES:** Based on mother's attained education - Some high school (7%); High School Diploma or Equivalent (29%); Some College (31%); 4-Year Degree or higher (33%)
- **Design:** Language and cognitive testing with a clinical psychologist
- **Measures:**
  - *Wechsler Intelligence Scale for Children (WISC-V):* Full Scale IQ and Verbal Comprehension Index Scale
  - *Peabody Picture Vocabulary Test (PPVT):* Receptive Vocabulary
  - *Expressive Vocabulary Test (EVT):* Expressive Vocabulary

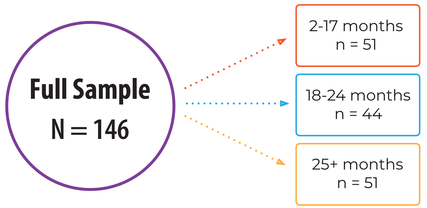
Conclusions

- Findings support the concept that **a child's early language experiences may predict developmental outcomes years later**
- Conversational turn-taking between 18-24 months was significantly correlated with later language and cognitive skills
- The use of automated analysis from recordings in the home language environment provides:
  - **An objective and non-invasive method** for assessing the strengths and weaknesses of a child's language environment
  - **An opportunity to design individualized family feedback**
  - **Potential for altering development trajectories,** especially of children living in impoverished language environments

LENA Metrics: Full Sample Correlations

Sample	N	WISC-V Full Scale IQ	WISC-V Verbal Comp	Vocabulary Receptive (PPVT)	Vocabulary Expressive (EVT)
Turns	146	.14	.27	.21	.21
Words	146	ns	.20	ns	ns

Age Groups:

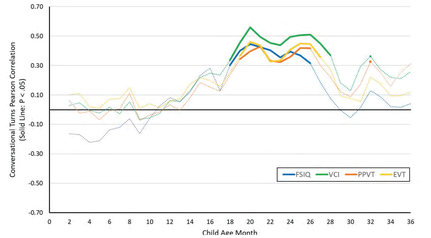


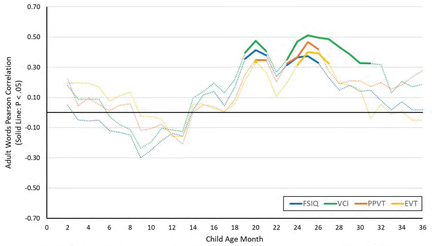
LENA Metrics: Age Group Correlations Controlling for SES

Sample	N	WISC-V Full Scale IQ	WISC-V Verbal Comp	Vocabulary Receptive (PPVT)	Vocabulary Expressive (EVT)
Turns					
2-17 M	51	ns	ns	ns	ns
18-24 M	44	.37	.52	.37	.38
25+ M	51	ns	ns	ns	ns
Words					
2-17 M	51	ns	ns	ns	ns
18-24 M	44	ns	.30	ns	ns
25+ M	51	ns	ns	ns	ns

p < .05

LENA Metric Correlations with Assessments Across Child Age





Note. LENA values at each age month are the average of counts for that month +/- 3 months. FSIQ= Wechsler Adult Intelligence Scale Full Scale Intelligence Quotient; VCI = Verbal Comprehension Index; PPVT = Peabody Picture Vocabulary Test; EVT = Expressive Vocabulary Test. Solid lines reflect correlations with p < .05.

Effect Sizes: Ages 18-24 Months Controlling for SES

Metric	% Outcome Variance Accounted for by LENA Metric: Full Scale IQ	Verbal Comp	Receptive Vocab (PPVT)	Expressive Vocab (EVT)
Turns	14%	27%	14%	15%
Words	ns	9%	ns	ns

Pediatrics, Volume 142, Number 4, October 2018
Bridging the Word Gap National Research Network Conference, 2019

Contact: JillGilkerson@LENA.org

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